Fossil Fuel Emissions and Children's Health, with Frederica Perera

Ernie Hood

Children are generally more vulnerable to environmental insults because their bodies are still developing, but just as early exposures can cause lifelong adverse effects, so can early interventions produce lifelong benefits. In this podcast, Frederica Perera discusses the potential long-term benefits of reducing children's exposures to combustion emissions by mitigating modern society's reliance on fossil fuels. Perera is director of the Columbia Center for Children's Environmental Health at the Mailman School of Public Health, at Columbia University in New York and the author of "Children are likely to suffer most from our fossil fuel addiction."

AHEARN: It's The Researcher's Perspective. I'm Ashley Ahearn.

Burning fossil fuels is bad for human health any way you look at it. We know fossil fuel combustion releases an abundance of toxic pollutants such as particulate matter and nitrogen oxides into the atmosphere.[1] We also know climate change—which is tied so closely to greenhouse gases emitted by burning coal, oil, and gasoline—is expected to adversely affect human health.[2] But who's harmed the most by fossil fuels?

Dr. Frederica Perera addresses just that question in a commentary published in Environmental Health Perspectives,[3] and she told science writer Ernie Hood why she believes kids are likely to suffer most from our reliance on fossil fuels.

Dr. Perera is the director of the Columbia Center for Children's Environmental Health at the Mailman School of Public Health in New York.

HOOD: Dr. Perera, how might global warming harm children in particular?

PERERA: Global warming, we think, is going to be harmful particularly to children. The average temperature of the earth is predicted to rise by as much as 2-4 degrees Celsius, and that kind of temperature increase could bring more heat waves, flooding, famine, and forced migration, along with the trauma and all those psychosocial effects. Children are

more at risk, biologically, of heat stroke, certainly of drowning, of malnutrition, diarrhea, allergies, and infectious disease, which is also predicted to increase as the result of global warming. And children are also more susceptible to psychological trauma. And the reasons they are more susceptible are biologic—the systems, organs, are rapidly developing and therefore more prone to insult. The immune system and other defense mechanisms are not mature as they are in adults, so that puts children, the very young (and I should include the fetus as well) at heightened risk and from our various studies internationally we have evidence of greater vulnerability to one of the primary pollutants that comes out of fossil fuel burning in addition to carbon dioxide, CO2—polycyclic aromatic hydrocarbons. The exposures prenatally to these PAHs that I mentioned, which are primary fossil fuel pollutants, toxic pollutants, that they are associated with reduced fetal growth, with more developmental problems at age three, with reduction in cognitive function at age five, and also in evidence of greater asthma risk in children.

And in these studies we have measured the adducts formed when these chemicals are breathed in by the pregnant mother and then are transferred across the placenta to the fetus, where they can be activated and bind to DNA. And we measure that biomarker, we call it, that fingerprint, in umbilical cord blood DNA, white blood cell DNA. And we've compared the level of damage to DNA from these PAH chemicals in the mother, taking a small sample of her blood at delivery and in the umbilical cord white blood cells, and we find that even though we know from many studies that the placenta is protecting the baby to a certain extent and reducing the exposure by about a factor of ten, despite that reduction of exposure to the fetus, the levels of DNA damage are equivalent in the newborn cord blood and in the mother. And that is indicating that the fetus is on the order of about ten-fold more sensitive to genetic damage from these chemicals.

Another manifestation of vulnerability could be more damage to what we call the epigenome, that is, not direct genetic damage but damage to the epigenetic or methylation programming of genes, such that they are abnormally expressed, or silenced during critical developmental periods. And we have found recently that these same chemicals, PAHs, do alter methylation patterns as we're measuring them, again, in the umbilical cord white blood cell DNA and there are many reasons why that could be potentially

serious in terms of chronic disease later on in the children.

HOOD: Dr. Perera, your article linked both the toxicity of fossil fuel burning emissions and the adverse effects of global warming with the unique vulnerability of the very young. Do you see the possibility of an interactive effect at work in terms of impact on children's health?

PERERA: My commentary set out to do something that I felt was needed, which was to link two areas of research and two areas of concern together, and to bring those together seeing through the lens of concern about the health of children. Because in the past, studies have focused on the toxic pollutants like PAH, or nitrogen oxides, or lead or mercury, or benzene from fossil fuel use, and then other studies have focused on the risk from climate change, not so much focusing on children, but some have touched on that area. But nobody had tried to pull it together, to think in terms of the cumulative risks, the interactive risks, and also the fact that if you turn things around in your mind, you can consider these risks and these health costs as benefits of taking action to reduce fossil fuel combustion and the exposures that emanate from it.

HOOD: Dr. Perera, you conclude the commentary with a call to action, stating that the needed solutions already exist to move away from fossil fuel use…and that implementing them is economically viable compared to the long-term costs of doing little or nothing. Do you see any signs that we are moving in that direction?

PERERA: Yes I do, and I think there are some very positive signs, and not only signs and talk, but action, and I'm so happy to see that, because it's been a long time coming. But we actually, now we have an administration and world leaders and also people who are able to put into effect these new technologies, and who see both the ecological health advantage and also the financial opportunities here. I see the will to take the actions to move toward reducing our reliance on fossil fuel and moving to cleaner or renewable alternatives and that makes me very happy to see, because I know that the benefits will be tremendous to our children and to future generations.

AHEARN: That was science writer Ernie Hood talking with Dr. Frederica Perera, director of the Columbia Center for Children's Environmental Health at the Mailman School of Public Health in New York.

And that's The Researcher's Perspective. I'm Ashley Ahearn. Thanks for downloading!

Ernie Hood is a science writer, editor, and podcast producer in Hillsborough, North Carolina. He also produces and hosts the weekly science radio show *Radio in Vivo*.

References

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[3] Perera FP. Environ Health Perspect 116(8):987–990 (2008); doi:10.1289/ehp.11173.